LAWRENCE LIVERMORE LABORATORY

Biomedical Sciences Division

March 3, 1978

Dr. Bruce W. Wachholz
Division of Biomedical and
Environmental Research
Department of Energy
Washington, D.C. 20545

Dear Bruce:

I am enclosing my thoughts about Project Indalo, including a brief history, a summary and recommendations. It turns out to be somewhat longer than two pages. Use any part of it you wish. I am also enclosing a copy of my 189 of last year, the new one is still being put together, and a retyped copy of the Hall-Otero agreement. I have begun work on the detailed plan.

Best regards.

Sincerely yours,

Phil

Phillip N. Dean

PND:pjm

Enclosures

PROJECT INDALO

On 17 January 1966 a U.S. Air Force B-52 bomber and a jet fuel tanker aircraft collided over the south-eastern coast of Spain. All four thermonuclear weapons survived the ensuing explosion and fell toward earth with parachutes deployed. One weapon fell into the ocean and was eventually recovered. A second weapon fell into a sand bank on the dry Almanzora river bed, the high explosive did not detonate and this weapon was quickly recovered. A third weapon struck the base of a rock wall at the edge of the village of Palomares, the high explosive detonated and the weapon burned. The final weapon fell onto a rocky area west of the village and also exploded and burned.

The burning of the two weapons resulted in extensive plutonium contamination of the surrounding area. A large effort was immediately organized to evaluate the situation in Palomares and to decontaminate the area. U.S. Air Force troops were used to accomplish the clean-up. The most heavily contaminated areas, around the impact sites and immediately downwind, were decontaminated by removing the upper few centimeters of soil. This soil was placed in steel containers and transported to the United States for burial. The remaining contaminated area which was under cultivation was deep plowed to disperse the plutonium and reduce its concentration to acceptable levels. The land not under cultivation, due mostly to its rocky character and/or poor accessability, was raked and watered in an attempt to fix the plutonium to the soil and thus prevent its resuspension.

The Spanish government, through the Junta de Energia Nuclear, established a surveillance program to follow the fate of the plutonium left on or in

the soil of Palomares, including its possible transport to man. The U.S. Atomic Energy Commission (now DOE) has participated in this program through an extension of a previous Agreement for Cooperation for Civil Uses of Atomic Energy between Spain and the United States. This extension, copy attached, calls for a four-point program designed to obtain information on 1) uptake and excretion of plutonium and uranium by a population group, 2) resuspension of plutonium from contaminated soil, 3) internal and external contamination of agricultural products, and 4) temporal migration and redistribution of plutonium oxide in soil.

The Spanish research program, supported in part by a small direct committment of funds and by a large commitment of equipment from the United States, has proceeded at a relatively low level since 1966. One area, noted as Area 3 on the attached map, was very well decontaminated. No plutonium activity has been detected in air, water or plants from this area, since 1966. The second weapon detonation site, Area 2, was not well decontaminated, due partly to its character and accessability and partly to its lack of use as cropland. Environmental monitoring in the vicinity of Area 2 also revealed no movement of plutonium until about two years ago. At this time the Spanish, pressed for arable land to raise their prinicple cash crop of tomatoes, started to till the hills around the Area 2 ground zero. This operation resulted in considerable resuspension of plutonium, contaminating not only tomatoes grown in Area 2 but also grain crops as much as half a mile away.

Although there is as yet no evidence of contamination of the residents of Palomares, plutonium is now being detected on or in their food crops. It is now time for a re-evaluation of the situation at Palomares. The data

obtained during the past 12 years should be summarized and examined, with a view toward establishing DOE recommendations for future efforts. Points to be addressed include 1) accurate surverys of current surface concentrations of plutonium, 2) future decontamination efforts, particularly in Area 2, 3) comprehensive environmental surveys of flora and fauna, and 4) more intensive and controlled monitoring of the people of Palomares. All of the efforts will of course have to involve the Spanish, with the bulk if not all of the on-site work done by them. The U.S. would act in an advisory role to provide technical expertise.

Madrid, Spain
February 25, 1966

Dear Professor Otero:

Pursuant to our Agreement for Cooperation for Civil Uses of Atomic Energy Between Spain and the United States I wish to propose that we expand our collaboration in the fields of health and safety. Accordingly, on behalf of the United States Atomic Energy Commission and in accordance with the relevant articles in our Agreement for Cooperation of August 16, 1957, as amended, I suggest we investigate various health and safety aspects of fissionable materials when released into a rural agricultural environment.

Collaborative investigations shall be initiated as soon as possible of the physiological and ecological behavior of plutonium oxide in a previously contaminated rural area that has been decontaminated in accordance with mutually agreed upon decontamination limits and procedures. More specifically the investigations shall consist of the points I have set forth in the attached annex to this letter.

It is understood that information considered essential to our collaboration shall be shared freely by the two agencies as well as all information derived from these investigations. It is further understood that the results derived shall not be released to the public without the concurrence of the two agencies.

If these proposals are acceptable to you, I suggest that this letter and your letter of acceptance shall constitute an understanding on these subjects between our two agencies.

Sincerely,

John A. Hall
Assistant General Manager for
International Activities
ATOMIC ENERGY COMMISSION

Enclosure: Annex

Exemo. Sr. D. José María Otero Navascues,
Marques de Hermosilla,
Presidente de la Junta de
Energia Nuclear,
Avenida Complutense 22,
Ciudad Universitaria.

AEC/JAHall:jdH:2/25/66

ANNEX

1. Collection of information on uptake and retention of plutonium and uranium by representative numbers of a population group potentially exposed to inhalation of a plutonium oxide aerosol.
2. Measurement of temporal and seasonal fluctuations in plutonium air concentrations above a plutonium oxide contaminated agricultural area that has been subjected to the agreed upon decontamination procedures.
3. Aerial measurements of contamination levels (both by plant uptake from the soil and wind dispersal) of agricultural products produced in a contaminated area subsequent to decontamination and,
4. Studies of the temporal migration and redistribution of plutonium oxide in soil, decontaminated by deep plowing, as a result of continued cultivation and weathering.

Annex

The Junta will assume the position of principal investigator with the U.S.A.E.C. providing support in the form of technical assistance and advice and speciallized equipment and materials not readily available to the Junta.

In the role of principal investigator the Junta will assume responsibility for the following:

1. Provision of buildings and laboratory space required to initiate and carry on the program.
2. Establishment, with the help of U.S. specialists, of sampling methods, routines and schedules for population, air, produce and soil measurements.
3. Provision of logistic support required by sampling and measuring schedules.
4. Performance of all scientific measurements and tests.
5. Compilation and documentation of all scientific data.
6. Provision of travel for its own specialists sent to the United States for consultation, planning or training purposes.

Annex

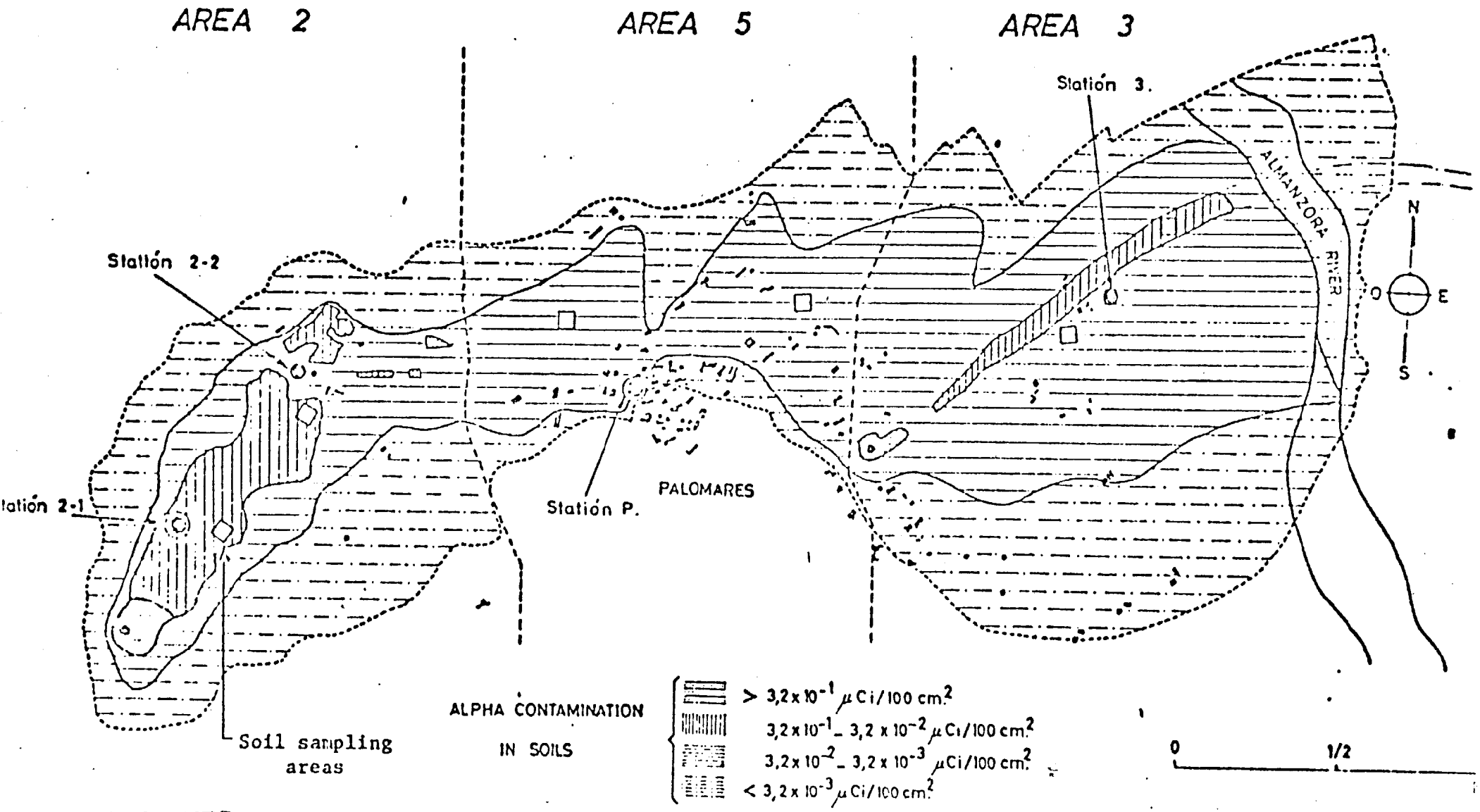
In the role of secondary investigator, the U.S.A.E.C. will assume responsibility for the following:

1. Provision, either through funding or by transfer, of specialized equipment and material required by the program. During the first year this will consist of:
   a. A whole body counter, complete with crystal spectrometer and plutonium X-ray detector.
   b. One (8 place) scintillation alpha counter of the type currently in use at the Los Alamos Scientific Laboratory or the New York Health and Safety Laboratory.
   c. One alpha spectrometer complete with multi-channel analyzer and data readout equipment.
   d. Additional, less specialized equipment, such as analytical balances, centrifuges, special chemicals, etc., in the amount of approximately $15,000.
   e. Plutonium and uranium analytical standards.
   f. Four generator-powered Hi-Vol air samplers of the latest design for continuous field operation.
2. Provision of a visiting specialist to install and calibrate the whole body counter and to train Junta personnel in its use.
3. Provision of visiting specialists in methods of plutonium and uranium analysis, to install specialized analytical equipment and train Junta personnel in techniques of plutonium and uranium measurement which are used in the United States, published and unpublished.

4. Provision of a visiting specialist in soil and plant sciences to help develop the studies of plutonium translocation in the soil and its uptake by cultivated crops.

5. Continued provision, beyond the first year, of specialized equipment, technical assistance and advice for as long as both parties mutually agree to be desirable on the basis of the observations as they are obtained.

Plutonium isopleths -- Palomares, Spain.



SCHEDULE 189

Lawrence Livermore Laboratory
University of California
Livermore, California

[X] Environmental Research & Development
[ ] Life Science Research & Biomedical Applications

1. CONTRACTOR: University of California, Contract #W-7405-Eng-48

2. PROJECT TITLE: Project Indalo - A Study of Plutonium in the Environment

2c. RPIS No. 002335

2b. ABSTRACTED TITLE: Project Indalo

2d. 189 No. LLL/AES-79-21

3. BUDGET ACTIVITY NO.:	4. DATE PREPARED:	5. METHOD OF REPORTING:	6. WORKING LOCATION:
RK-02-01-01	April 1977	Annual	Livermore, California

7a. PERSON IN CHARGE: M. L. Mendelsohn

7b. PRINCIPAL INVESTIGATOR: P. Dean

8. PROJECT TERM: Continuing

9. MAN YEARS:

		FY 78				FY 79		
	FY 77	Pres. Budget	Reprog.	New K$	TOTAL	Option A	Option B	Option C
(a) Scientific	0.3	0.3	0	0	0.3	0.3	0.3	0.3
(b) Otner Technical	0	0	0	0	0	0	0	0
Total	0.3	0.3	0	0	0.3	0.3	0.3	0.3

10. FUNDING:

		FY 78				FY 79		
	FY 77	Pres. Budget	Reprog.	New K$	TOTAL	Option A	Option B	Option C
Operating Costs:								
(a) Manpower	8	8	0	0	8	9	9	9
(b) Materials, Services, etc.	17	19	0	0	19	20	20	20
(c) Indirect Expenses	5	6	0	0	6	6	6	6
Total Operating Costs	30	33	0	0	33	35	35	35
Capital Equipment not Related to Construction	0	0			0	0	0	0

11. REACTOR CONCEPT: Not Applicable

12. MATERIALS: Not Applicable

DOE ARCHIVES

13A. PUBLICATIONS:

None.

13B. PERSONNEL:

Not applicable.

14A. SCOPE ABSTRACT:

In February 1966 the Agreement for Cooperation for Civil Uses of Atomic Energy between Spain and the United States was expanded to include collaborative investigations of the physiological and ecological behavior of plutonium oxide in a contaminated rural agricultural environment. This Hall-Otero agreement established what is known as Project Indalo, a four-point program designed to obtain information on 1) uptake and excretion of plutonium and uranium by a population group, 2) resuspension of plutonium from contaminated soil, 3) internal and external contamination of agricultural products, and 4) temporal migration and redistribution of plutonium oxide in soil. In an annex to this agreement, the AEC (now ERDA) agreed to "continued provision, beyond the first year, of specialized equipment, technical assistance and advice for as long as both parties mutually agree to be desirable on the basis of the observations as they are obtained". In the past this assistance and advice has been rendered informally with no direct regular contact, particularly since 1972. To provide for maximum utilization of information obtained from Project Indalo, this project will establish regular and continuing contact with Spanish investigators.

14B. SCOPE:

The agency responsible for Spanish participation in the agreement outlined in 14A is the Junta de Energia Nuclear (JEN) through its Division de Medicina y Protection (under the direction of Dr. Emilio Iranzo). The Junta is a part of the Ministry of Industry. The objective of this 189 is to establish regular and continuing contact with the JEN regarding Project Indalo. Through this program, ERDA will be provided with direct input to the Spanish experimental program. The Spanish investigators will be provided with technical advice and information as they request it and as ERDA feels necessary from sources both within and outside the Laboratory. The expertise of the Environmental Sciences Division and of the Hazards Control Department of LLL are readily available. Data obtained by the Spanish investigators will be reviewed on a continuing basis and they will be assisted in preparing the data for publication.

Additional equipment needs of the Spanish research group will be handled through this Laboratory with special funds provided by ERDA as required. To provide coordination of this program with ERDA Headquarters and to have more than one person fully cognizant of the current status of the program, a small committee has been formed composed of Martin Minthorn (ERDA), Chester Richmond (ORNL), and Phillip Dean (LLL). This committee will meet at least annually to review the program and evaluate equipment requests.

The principal investigator in this 189 has been associated with Project Indalo since its origin in 1966 and is the primary technical contact in the United States for the JEN and acts as liaison between the JEN and ERDA. To maintain close contact with the Spanish investigators, the JEN is visited annually, and JEN personnel will be encouraged to visit laboratories within the United States.

15. RELATIONSHIP TO OTHER PROJECTS:

This program is closely related to efforts within the Environmental Sciences Division and with the Hazards Control Department to assess the dose to man from plutonium in the environment.

16. TECHNICAL PROGRESS IN FY 1976:

Program advisory committees were established within ERDA and the JEN. A comprehensive research program review is underway and the Spanish researchers are preparing a summary of data obtained in Project Indalo. The JEN and ERDA have increased their support of the project, permitting increased effort in the soil- and vegetation-sampling program.

The chief of the JEN-chest (lung) and total body-counting program, Dr. Francisco de los Santos, was brought to the United States to provide him with direct experience in U.S. counting programs and with our measurement techniques. He visted and worked with three laboratories: LLL, LASL, and New York University. The knowledge and experience gained by Dr. Santos during his visit will be very useful both to Project Indalo and the general Spanish radiation protection program.

A visit to the JEN will be made in the second half of FY 1977 to review current data and assist the JEN in planning future efforts.

17. EXPECTED RESULTS IN FY 1978:

The Project Indalo research program will be reviewed continuously and modified when indicated by current data. Close contact will be maintained with the JEN to assure a prompt response to any questions or problems that might occur. The JEN will be provided any support within our means to help them carry out their programs.

18. EXPECTED RESULTS IN FY 1979:

The studies currently underway will be continued without changes except as dictated by results.

19. MAJOR MATERIALS, EQUIPMENT, AND SUBCONTRACT ITEMS:

None.

20. PROPOSED OBLIGATIONS FOR RELATED CONSTRUCTION PROJECTS:

None.